

AUTOMATED MANUAL TRANSMISSION FOR TWO WHEELER

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ABSTRACT

Amidst the fast development road transport infrastructure in nation, the two wheeler population is increasing day by day where the supplies for profitable and economical two wheelers are acquiring high. For the need of better torque and fuel efficiency, gearbox is furnished in the two wheelers. Though the manual gearbox has lot of merits, it also has demerits on complexness of changing the gears with detail to driving necessitate. To avoid the complexness in driving, the continuous varying Transmission are provided in two wheelers, but due to the slip taking place in the belt, the overall efficiency has been decreased. So, in order to reduce complexity of impulsiveness and at the same time providing the better fuel economy, the manual transmission can be machine-driven through electrical aid with the help of electronics.

The automation of the existent manual transmission can be made by actuating the clutch, gear shifter lever by acquiring the information from the wheel speed sensor, load sensor, throttle position sensor. The gear shifter and clutch are motivated with the help of stepper motor in a bid to supply better preciseness. Potentiometer is used to alert the throttle position and a load cell is used to sense the load of the driver and pillion. The control system (ARDUINO UNO) acts as a bridge between the sensor and actuator.

KEYWORDS: ARUDINO, Servo Motor, Liquid Crystal Display, Throttle Position Sensor, Speed Sensor, Load Cell & Battery

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INTRODUCTION

A Transmission is a device in a power transmission system, which renders controlled application of power. Rarely, the term transmission refers just to the gearbox that uses gears and gear trains to supply speed and torque interpretation from a rotating power source to instrumentation. The most popular use is in motor vehicles, where the transmission changes the production of the internal combustion engines to the drive wheels. Such engines need to run at comparatively high rotational speed, which is unsuitable for starting, stopping and slower travel. The transmission cut down the higher engine speed to the lower wheel speed, accelerate torque in the process. Transmission is also used on pedal bicycles, fixed machines, and wherever various speeds and torques are altered.

At lower speeds, the torque given out by an I.C engine is scanty, which can be increased with an increase in speed; it reaches a maximum at optimal speed and starts attenuating on the far side that. This also attributes to the fact that if the engine is directly linked to the wheels in contact with the road, there might be deficit in friction to start the vehicle from its idle position. The applicable circumstance for the running of car under variety of situations which requires diversity of torque supplied to road wheels, which would also mean that it would not to be

achievable to regularly run the engine at the optimal speed. Likewise, the bigger engine would be needed to cater to the torque responsibility under most hard situation. The cardinal aspect of this transmission is to provide means to vary torque ratio between road wheels and engine as demanded. This also gives an inert position by which engine and wheels come in neutral alignment with the clutch in the occupied posture. This means that the car can utilize by reversing the direction of drive rotation supplied from the transmission.

A motorcycle or ATV manual transmission improves change by allowing the rider to alter the engine to rear wheel drive ratio. Lower gears, the transmission ratio is enlarged to provide better torque and acceleration fully at high gear; the ratio is lower for decreased engine speed, fuel consumption, engine noise, and wear.

A multi speed transmission consists of two shafts with two or more gears on each shaft. Activity of a multi speed transmission is comparatively simple, if you have a basic perceptive of the principles concerned. A few multi speed transmission thought are. One pair of gears is used for each transmission ratio; one gear may free-wheel while the other gear is locked to the shaft. The gear ratio is less when the gear on the input shaft is large. The gear which is the largest on the input shaft is highest gear, similarly the smaller the gear on the input shaft, the higher the gear ratio. The smallest gear on the input shaft is first or low gear. A typically, all gear teeth are engaged at all times. However, only one gear is present in the input shaft and its output mate mortal power.

In the constant mesh transmission of the power is transmissible done the clutch to the main shaft. From the main shaft, power may be genetic, through, several gears sets to the counter shaft. M1 through M5 are the main shaft gears and then C1 to C5 are counter shaft gears. The gears sets comprise lever of opposing gears, with one gear on per shaft. Furthermore, the gears set coupling the main shaft number with the counter shaft number (M1/C1, M2/C2, etc.)

Choice for the apt set of gears is completed by oncoming a sliding gear into interaction to the gear set desirable. Relation of the sliding gear and the gear set is achieved by exploitation dogs and the dog holes present in the sides of gear. The gears namely, M3, C4, C5 are the sliding gears. The sliding gears are stirred by shift frocks which ride above the shift drum. Also, the grooves of the cam are cut in the shift drum which moves the shift frocks simultaneously when drum rotates. Shift drum rotation is done by employed the gear shift pedal.

Common gearbox used two methods of directional power through the transmission; Direct Drive and Indirect Drive. In most cases, the direct drive transmission has the clutch and counter shaft sprocket set on the same side of the engine. The transmission input shaft passes through the middle of the drive trammel counter shaft sprocket. The counter shaft sprocket is strip to the high gear pinion construction. The second shaft is called the lay shaft. All ratios in a direct drive transmission ends up driving the counter shaft sprocket through high gear. The dual range transmission is used in some small-scale motorcycles, touring bikes, and some ATVs as it supplies a dual range gear ratio for both on and off -high way use. The dual range transmission has an auxiliary transmission often called a sub transmission set between the received transmission and final drive in the power flow system. In splendor, the constant mesh gearbox is used which is basically a portion of the manual transmission.

EXPERIMENTAL SETUP

The major components which constitute the setup are clutch throttle, water-cooled petrol engine, dynamometer and a controller. The dynamometer is based on Eddy-Current theory. The Clutch throttle is connected to the engine and the output shaft from the engine attached to the Eddy-Current dynamometer. A speed sensor is directly placed adjacent to the

speed encoder in the Eddy-current dynamometer. The speed sensor measures at which speed the dynamometer shaft is rotating. The load can be given by means of the controller. There are two displays which indicate the speed and load at which the dynamometer is subjected to. The upper limit of dynamometer cooling water temperature is 60°C; cooling water inlet temperature is 35°C to provide better operation.

SPECIFICATIONS

- Make Technomech
- Mode TMEC-10
- Speed 1500– 6000 rpm
- Max power 7.5kw
- Cooling type Water Cooled

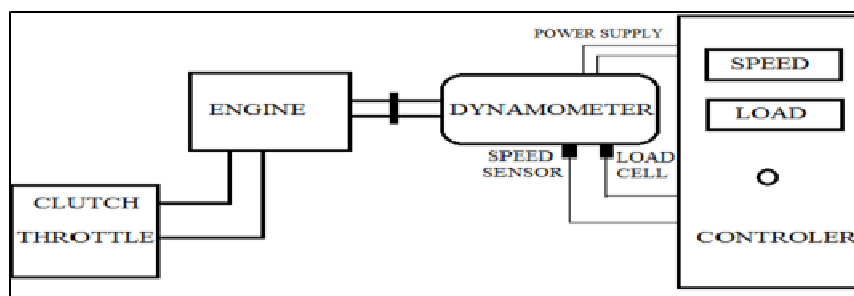


Figure 1: Block Diagram of the Experimental Setup.

RESULTS AND DISCUSSIONS

The torque needed to get over the resistance and inertia of the vehicle at antithetic speed is calculated. The table 1 entertainment the torque necessary at various speeds to furnish the requisite acceleration of the vehicle. The torque available at various throttle position is measured at various speed at different gears.

Table 1: Tractive Effort and Torque required at various Speed for $m = 186.4\text{kg}$, $W = 182.584$, $\mu = 0.4$

S. NO	V (Km/hr)	F_R (N)	F_W (N)	A (m/s^2)	F_T (N)	T_r (N/m)	Speed (rpm)
1	10	19.4	1.1	2.62	510.6	116.7	116
2	15	20.0	2.6	2.62	511.1	116.8	175
3	20	20.5	4.7	2.60	511.7	116.9	233
4	25	21.1	7.4	2.59	512.3	117.1	290
5	30	21.7	10.7	2.57	512.9	117.2	349
6	35	22.2	14.5	2.55	513.4	117.3	407
7	40	22.8	19.0	2.53	514.0	117.5	465
8	45	23.4	24.0	2.50	514.6	117.6	523

TORQUE AVAILABLE AT DIFFERENT THROTTLE POSITIONS AT DIFFERENT SPEEDS

Table 2: Tabulation of Results obtained from the Engine using Eddy Current Dynamometer

Gear	Throttle Position (degrees)	Gearbox Output Shaft		Road Wheel	
		Speed (rpm)	Torque (Nm)	Speed (rpm)	Torque (Nm)
1	36	241	10.8	78	33.1
	72	287	34.8	93	106.8
	108	338	53.8	110	165.1
	144	370	78.0	120	239.4

	180	466	64.0	152	196.4
2	36	415	6.4	135	19.6
	72	495	20.2	161	62
	108	582	31.1	190	95.4
	144	640	45.2	208	138.7
	180	803	37.1	262	113.8
3	36	540	4.	176	15
	72	15.5	641	47.5	208
	108	24.0	757	73.6	246
	144	34.8	829	106.8	270
	180	28.6	1045	87.8	340
4	36	3.5	750	10.7	244
	72	11.2	890	34.3	290
	108	17.3	1050	53.1	342
	144	25.5	1150	78.2	375
	180	20.6	1450	63.2	472

The torque accessible at the gearbox output shaft is lost at various throttle position and at different speeds using eddy current dynamometer, conjugated to the two wheeler engine is set in the table 2. At basic, the throttle position is set and the torque available at the speed is recovered for different gears. Then, the throttle is accrued and related torque is calculated. The acquirable torque is compared with the torque needful at various speeds. Thus, the reckon upon the satisfaction of the torque gear shifting is made. The torque accessible at that throttle position and vehicle speed is equal to torque needed. The torque required to defeat the resistance is accessible at the upcoming gear.

AUTOMATION

Automation can be characterized as the application by which an activity is performed without human aid. The automatic control, as the name suggests is a use of different control systems in operational instrumentation like boilers, factories processes, and machinery, turning on telephones, networks, airplanes, stabilizing ships, different hold and vehicles etc., with minimal to no human involvement. Few activities are totally machine-driven. The term automation is a method that can be used to bring down labor costs with better quality. Automation can cut down process time. Automation can track to products having accordant quality, possibly even systematically good quality. Automation is a technology taken up with request of mechanical, electronic and computer-based system to direct and control system.

CONTROL SYSTEM

A control system is a scheme, which provides the sought-after effect by dominant the output. The control system gets information from different sensors and influences those data and in turn, signals the actuators to absolute operation. The control system consists of two kinds, namely, open loop and closed loop. Firstly, the open loop system does not take any feedback from the output to check whether the operation is going as desired. On the other hand, closed loop system takes the feed-back from the product and check whether the procedure is going in correct manner. The control system that we use is the Arduino uno for dominant the sensors and actuators.

ARDUINO

The open-source program utilized for storing up contraptions adventures is finished with Arduino. Subsisting with both a physical adjustable circuit board and a piece of programming, Integrated Development Environment that has tribulation effect on your PC, used to shape and move PC tag to the physical board.

The Arduino stage has pushed toward turning into a noteworthy and most adored with people basically opening out with equipment, and for getting things started. Unlike, most programmable circuit sheets, the Arduino doesn't really direction a separated piece of gear to stack early code onto the commission; you can basically utilize a USB line.

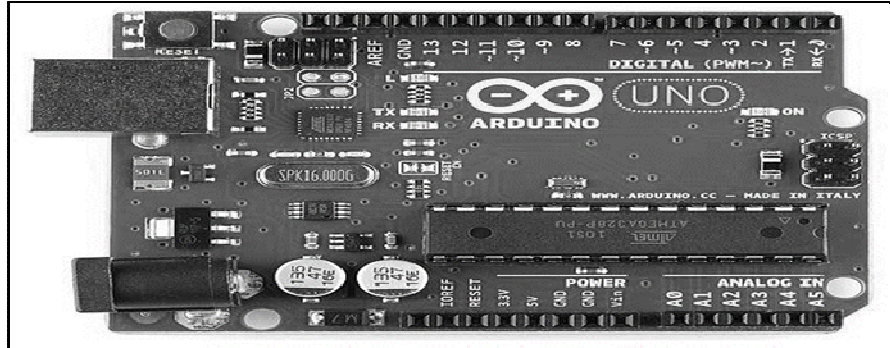


Figure 3: Arduino.

In additament, the Arduino IDE utilizes a simple type of C++, coming up with it progressively easy to get to program. Last, Arduino render a rule structure factor that breaks out the demonstration of the scaled down scale controller into an undeniably friendly bundle.

The Arduino Uno is a microcontroller show board built on the ATmega328 datasheet. It has 14 modernized information/yield pins (of which 6 can be utilized as PWM yields), 6 straightforward information sources, a 16 MHz masterful resonator, a USB interface, a power jack, an ICSP heading, and a reset catch. It contains everything expected to fortify the microcontroller; essentially interface it to a PC with a USB connection or power it with an AC-to-DC connector or battery to start inception.

The Arduino Uno can be control driven by methods for the USB affiliation or with an internal supply of power. The puissance source is isolated normally. External power is obtained from an AC-to-DC connector. The connector can be related by halting a 2.1mm center positive connection into the board's puissance jack. Leads from a battery can be territory in the Gnd and Vin stick headers of the POWER affiliation. The board can't chip away at an outside supply of 6 to 20 volts. If demand with under 7V, regardless, the 5V stick may supply below five volts and the board may be perilous. In case of utilizing more than 12V, the voltage control may sultry up and hurt the board. The proposed augmentation is 7 to 12 volts.

The power pins are as follows:

Vin - The input voltage to the Arduino board when it uses an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. **5V** - This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7–12V), the USB connector (5V), or the Vin pin of the board (7–12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

ROTARY POTENTIOMETER

A typical potentiometer consists of three terminals which acts a voltage divider. In this experiment, we use rotary potentiometer which is widely used. When it is attached to a shaft, the wiper inside it shows the resistive value.

SERVOMOTORS

Servo motor is a motor which has degree orientation of 0 to 180 degree. Sometimes, based on the type of manufacturing, it can go as far as 210 degree. The degree rotation is dependent on electrical wave width, which is given to the control pin. The pulse is checked every 20 ms by the motor.

Usually +5V supply tends to work for almost all servo motors. In some cases, if the actual required amount of current is more, it might burn the Arduino board, so it is advisable to use regulated external power supply of 4v to 6v.

INDUCTIVE PROXIMITY SENSOR

This type of sensor is used to spot a target which is usually ferrous metal, without actual contact with them. There are three types of inductive proximity sensor. These are usually durable, strong and maintenance free.

- When speed sensor sends the signal to the control unit to perform future operations.
- We chose M18DPO for this project, which is manufactured by Advance Tech. This sensor has good dimensional accuracy and unmatched quality.
- This is oscillating type which has high frequency and works on the basis of electromagnetic induction.

LIQUID CRYSTAL DISPLAY

The Liquid Crystal library sanctions you to control LCD displays that are coordinated with the Hitachi HD44780 driver. There are huge numbers of them out there, and you can ordinarily let them know by the 16-stick interface. The LCDs have a parallel interface, betokening that the microcontroller needs to control a few utilizer interface sticks without a moment's delay to control the show. The interface comprises of the accompanying pins:

- A register winnow (RS) stick that controls in the LCD's memory location is where you are writing information to. You can winnow either the information register, which holds what goes on the screen, or an ordinant correspondence register, which is the place the LCD's controller tests for injunctive approvals on what to do straightaway.
- A Read/Inscribe (R/W) stick that winnows understanding mode or inditing mode
- An Enable stick that empowers writing to the registers
- 8 information pins (D0 - D7). The conditions of the pins are of the bits that are being written to a register when you record, or the qualities you are perusing when you read.
- There's withal a display complexity stick (Vo), control supply pins (+5V and Gnd) and LED Backlight (Bklt+ and Bklt-) pins that you can use to control the LCD, control the show differentiation, and turn on and off the LED backdrop illumination, separately
- The procedure of display command includes putting the information that structure the picture of what you optate to show into the information registers, at that point placing injunctive approvals in the ordinant transcription register. The Liquid Crystal library disentangles this for you so you don't require to ken the low-level ordinant transcriptions.

- The Hitachi-good LCDs can be commanded in dual methods: 4-piece or 8-piece. The 4-piece mode requires seven I/O pins from the Arduino, while the 8-piece mode requires 11 pins. For showing content on the screen, you can do most everything in 4-piece mode, so model tells the best way to control a 2x16 LCD in 4-piece mode.

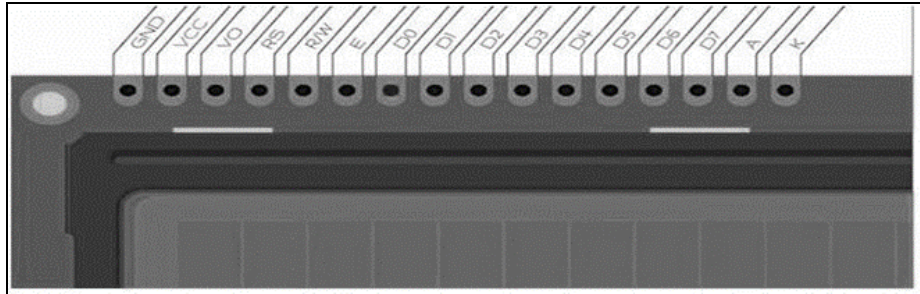


Figure 4: Pin diagram of Liquid Crystal Display.

SPST SWITCH

SPST switch stand for single-pole, single-throw switch. The working of this switch is simple. This switch has an input and an output. It is either totally connected or disconnected. These switch's sole purpose is turn on and off. SPST switches have two ends. A SPST switch is a switch that only has a single input and can link only to one output. This means, it only has one input end and only one output end.

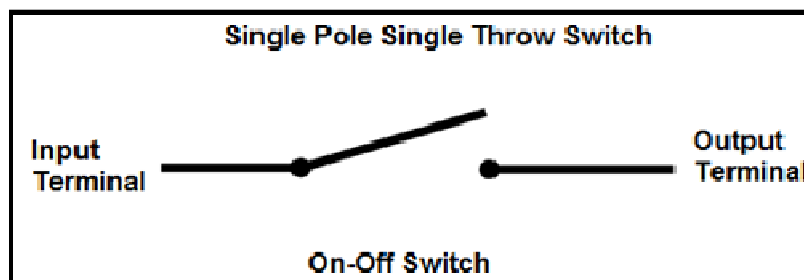


Figure 5: Single Pole Single Throw Switch.

THROTTLE POSITION SENSOR AND ACTUATOR

This sensor (TPS) is an integral part of a vehicle's fuel governance system, and it helps ascertaining the accurate mixture amount of air and fuel, that is being delivered into the engine. TPS sends a signal mentioning power requirement by the engine to the fuel injection system. The TPS signal is continually metrical and united many times per second with other information such as air temperature, engine speed, mass flow, and how rapidly the throttle position changes. These data find out exactly how much fuel to inject into the engine at any taken instant.

Automotive vehicles use the throttle valve to regulate the air and fuel flow amount entering into the combustion chamber of an engine to produce a somewhat comparable constant air-fuel ratio and thus giving us control over the regulation in power generated from the engine. For an engine fitted with a traditional carburetor, the pedal of the accelerator is connected to the throttle valve by a metal cable. When the pedal is down, the throttle valve allows excess air and fuel to flow by opening into the combustion chamber, thereby leading to growth in engine power respectively. Fortunately, this kind of carburetor attributes to the decrease in efficiency. The Engine Control Unit (ECU) measures the set point acquire from the present point in the accelerator and then it makes the servo motor to denote the precise position of throttle valve which radio-controlled by the throttle valve position sensor.

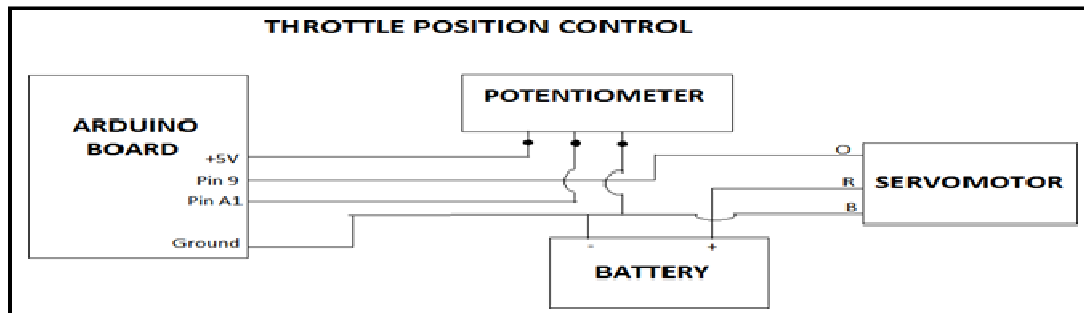


Figure 6: Circuit Diagram of Throttle Position Sensor and Actuator.

The connections given as per the diagram shown above represents that the positive and negative ends of battery that is connected to the red and black wire of servomotor respectively. Potentiometer end pins are related to the pin of +5V and ground pins. The middle pin is attached to A1 of Arduino board respectively. Pin 9 of Arduino board is related to the orange wire of servomotor. Ground of Arduino is related to the negative end of the battery. The force required to set off the accelerator cable is 1.6 kg.

SPEED SENSOR

A vehicle speed sensor is a sensor that determines whether an object is present or absent with the help of electromagnetic fields, sound, and light. Depending on the application, different kind of speed sensor is employed.

CLUTCH CONTROL MECHANISM

The clutch is electronically actuated through with the stepper motor reported to the signal from the control system. This innovation relates to motor vehicles and more peculiarly to clutch control devices, therefore, intentional mostly for the purpose of automatically act the clutch, as and when requisite in order to disconnect the driving wheels of a vehicle from the engine, thereby allowing shifting of gears. Then the clutch is set-aside automatically.

GEAR SHIFTING CONTROL

The gear shifting operation is automatic by use of servomotor to trigger the gear shifting lever placed near the footrest of a driver in two wheelers. The servomotor can turn 0 to 90° both in clockwise and anti-clockwise position. When the motor twist in the clockwise direction, upward shift is made and likewise downward shifting is ready-made, when it turns in the anti-clockwise direction. By giving decent pulse, the direction of turn of the servo motor is precisely contained. The proper pulse is given by the control system accordant to the requirements. The links are given as per the diagram shown above. Connect Pin 5 of Arduino Board is to the orange wire of servomotor, connect the ground of Arduino attached to the negative end of battery and to the black wire of servomotor. Positive point of battery is connected to the red wire of servomotor.

COMBINED CIRCUIT DIAGRAM

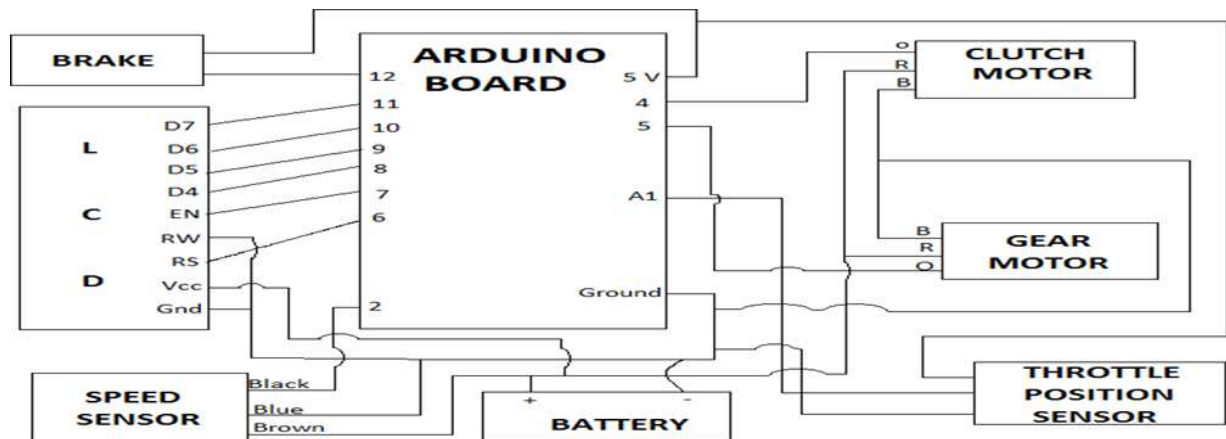


Figure 7: Combined Circuit Diagram.

DESCRIPTIVE DIAGRAM

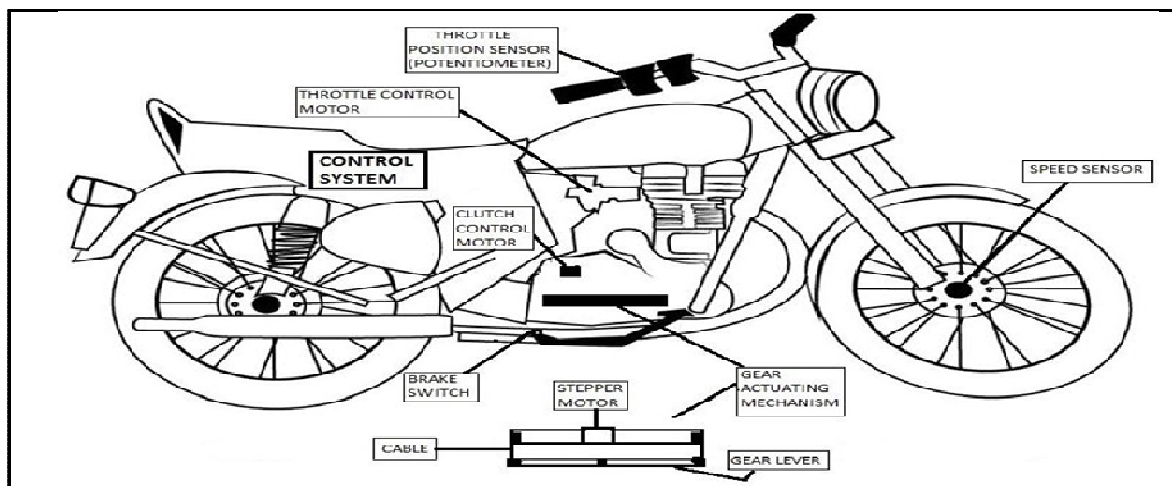


Figure 8: Descriptive Diagram.

PROTOTYPE

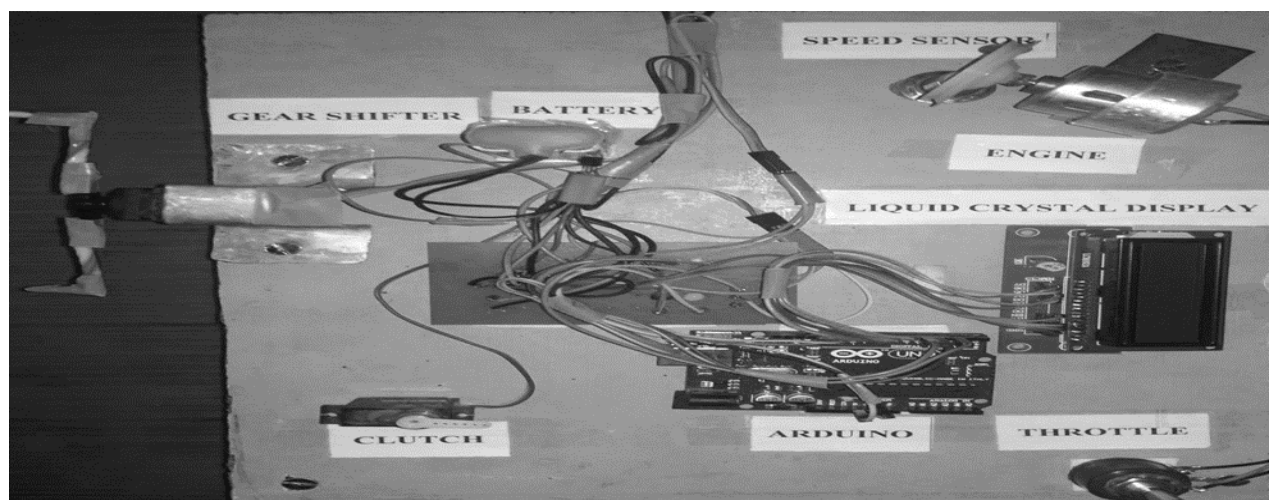


Figure 9: Prototype.

DISCUSSIONS

ADVANTAGES

- Even a physically challenged person can ride the motorcycle very well.
- No necessary to be skilled anymore to ride meshed bikes.
- Aid to shift gears in a tensionless manner and in correct timing.
- No need to buy a gearless bike, just modify our geared bike by commencement of this kit.
- Efficiency of the vehicle fold by shifting the gears on correct time.
- Motorcycle looks great than a Scooty.

DISADVANTAGES

- Compared to the manual transmission, its structure and design is complex.
- Dependability of the electrical factor

CONCLUSIONS

AMT is a cognitive content under attention for the past few years. It has been used in some four wheelers, but not in two wheelers due to the bulge size of hydraulic engines. If AMT has to be introduced in two wheelers, it can be only accomplished through a fully electronic control system. In our system, we are fairly arrogant to say that, we have achieved it to a great level in this paradigm. We are prospering in dominant clutch and gear and its shifting consequently. The benefit of AMT besides the easiness in driving, and better vehicle control during heavy traffic, it also actually makes the vehicle fuel optimized. Now the existing practical applications are concentrated in processing fuel efficient vehicles and this is a crucial part of it. With AMT, we can accomplish fast transmission between gears and speed change. This cuts down the decrease of fuel during slowing down of the vehicle, to change gear. Thus, fast shifting of gears add on to acceleratng the distance of the vehicle, compared to the others. When reasoned for an elaborate study, it can be seen that the merits of this system does not end here and can be further drawn-out in specialized and technical position. Our method is just a first initiative and it has much forthcoming expectation. With more skillful procedure and constituent, this can be built far. We hope to develop this idea to a more innovative and perfect mechanism as such and it can be commercialised in the future.

ACKNOWLEDGEMENT

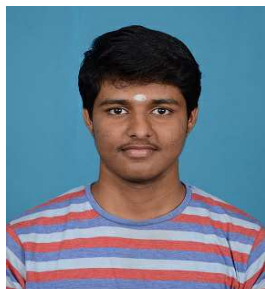
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